Real-Time Control Application Software
Integrated Product Team
Atlas DP1

Checkout and Launch Control System (CLCS)

84K00303-011

Approval:

Chief, Hardware Design Division	Date	Chief, System Engineering and Integration Division	Date
Chief, Software Design Division	Date	CLCS Project Controls Office	Date
Chief, System Applications Division	Date	Project Manager, CLCS	Date

NOTE: See "**Supporting Document Note**" on following page

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Supporting Document Note:

Acronyms and definitions of many common CLCS terms may be found in the following documents: CLCS Acronyms 84K00240 and CLCS Project Glossary 84K00250.

REVISION HISTORY

REV	DESCRIPTION	DATE
Basic	Promoted per approval by Design Panel (cam)	5/19/98

LIST OF EFFECTIVE PAGES				
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Page No.	**A or D***	**Issue or Change No.**	**CR No.**	**Effective Date****

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1. INTRODUCTION

1.1 RTC IPT OVERVIEW

For Atlas, two Real-Time Control (RTC) Application Software Integrated Product Teams (IPT's) will continue work and four IPT's will be started.

IPT	Continue in Atlas	Start in Atlas
Hypergolic Maintenance Facility (HMF)	X	
Vehicle Power Up/Down	X	
Orbiter/Solid Rocket Booster (SRB) Hydraulics		X
Hazardous Gas (HAZGAS)		X
Cryogenics, Main Propulsion and FIREX Water		X
Launch Operations		X

HMF

This Integrated Product Team (IPT) is responsible for the definition, design, and development of the Hypergolic Maintenance Facility (HMF) Real-time Control (RTC) Application Software. This includes software to support the check-out and maintenance of the Forward Reaction Control System, (FRCS) Aft Propulsion System (APS) and portions of the Orbiter Maneuvering System (OMS) Thrust Vector Control System . The completion of this IPT's software development will be in the post-Atlas time frame.

Vehicle Power Up/Down

This Integrated Product Team (IPT) is responsible for the definition, design, and development of the Real-Time Control Application software to support the automated power up/down of the Space Shuttle. The includes the auto power up/down sequence which is required by the Test Project Engineer (TPE), and the supporting subsystem software for the following systems: Data Processing System (DPS), Environmental Control and Life Support System (ECL), Electrical Power and Distribution System (EPD), and Instrumentation System (INS). This Application Software not only includes power up/down sequence functionality, but the components required by these systems to monitor GSE and Flight Hardware when that hardware is active. The completion of this IPT's software development will be in the post-Atlas time-frame (scheduled completion is Titan).

Orbiter/SRB Hydraulics

This Integrated Product Team is responsible for the definition, design and development of the Real-Time Control Application Software to support the checkout and operations of the Ground Support Equipment (GSE) functions for the Orbiter and SRB Hydraulics systems. The completion of this IPTs software development will be in the post-Atlas time frame (currently scheduled for Titan).

HAZGAS

This Integrated Product Team is responsible for the definition, design and development of the Real-Time Control Application Software to support the checkout and operations of the Hazard Warning System (HWS) and Hazardous Gas Detection System (HGDS). HGD/HWS is exclusively controlled through GSE and is located in the OPF, MLP, Pad and HGDS Lab areas. The completion of this IPT's software development will be in the post-Atlas time frame (currently scheduled for Titan).

Cryogenics, Main Propulsion and FIREX Water

This Integrated Product Team is responsible for the definition, design and development of the Real-Time Control Application Software to support the checkout and operations of the Ground Support Equipment (GSE) functions for the Liquid Hydrogen (LH2), Liquid Oxygen (LO2), Main Propulsion System (MPS) and Space Shuttle Main Engine (SME) systems, plus the portions of the FIRE Water (WAT) GSE operated by MPS. The completion of this IPT's software development will be in the post-Atlas time frame (currently scheduled for Scout).

Launch Operations

This Integrated Product Team is responsible for the definition, design and development of the automated Ground Launch Sequencer (GLS) and related launch operations application software. The completion of this IPT's software development will be in the post-Atlas time-frame (currently scheduled for Saturn).

1.2 RTC IPT CONCEPT

CSCI's Included

The RTC Application Software developed by these IPT's will include the following CSCI's. The table below indicates whether the IPT will complete all or part of the CSCI and also lists future related IPT's if applicable. The Common Application Support (CAS) CSCI is a repository for software components which individual CSCI's develop for their IPT and other CSCI's can reuse.

IPT	CSCI's Included	All/Part	Future Related IPT's
All	CAS	Part	All
HMF	HMF	All	N/A
Vehicle Power Up/Down	DPS	Part	Avionics/Electrical (OPF)
	ECL	Part	ECL/PRSD (GSE), ECL/PRSD/Fuel Cells (OPF)
	EPD	Part	Avionics/Electrical (OPF)
	INS	Part	Avionics/Electrical (OPF)
	INT	Part	Launch Operations (Integ Ops)
	MST	Part	All Other Systems (GSE), Launch Operations (Integ Ops)
Orbiter/SRB Hydraulics	BHY	Part	HYD/Flight Controls (OPF)
	HYD	Part	HYD/Flight Controls (OPF)
HAZGAS	HWS	All	N/A
Cryogenics, Main Propulsion and FIREX Water	LH2	Part	Cryogenic Load (Integ Ops), Launch Operations (Integ Ops)
	LO2	Part	Cryogenic Load (Integ Ops), Launch Operations (Integ Ops)
	MPS	Part	MPS (OPF), Cryogenic Load (Integ Ops)
	SME	Part	MPS (OPF), Cryogenic Load (Integ Ops)
	WAT	All	N/A
Launch Operations	GLS	All	N/A

IPT	CSCI's Included	All/Part	Future Related IPT's
	INT	Part	N/A
	LH2	Part	N/A
	LO2	Part	N/A
	MST	Part	N/A

RTC Application Software Architecture

The software architecture of all IPT's will follow the RTC Application Software Architecture Standard 84K01710. Software design information will be contained in the Overview Design Specification (ODS) document for each CSCI. The design specification for software components which are reused by multiple CSCI's will be contained in the ODS for CAS.

IPT	CSCI	ODS	Delivery Produced
All	CAS	84K01250-200	Atlas
HMF	HMF	84K01360-200	Thor (FRCS), Atlas (APS)
Vehicle Power Up/Down	DPS	84K01280-200	Atlas
	ECL	84K01290-200	Atlas
	EPD	84K01320-200	Atlas
	INS	84K01400-200	Atlas
	INT	84K01380-200	Atlas
	MST	84K01460-200	Atlas
Orbiter/SRB Hydraulics	BHY	84K01230-200	Atlas
	HYD	84K01350-200	Atlas
HAZGAS	HWS	84K01370-200	Atlas
Cryogenics, Main Propulsion and FIREX Water	LH2	84K01420-200	Atlas
	LO2	84K01430-200	Atlas
	MPS	84K01450-200	Atlas
	SME	84K01500-200	Atlas
	WAT	84K01510-200	Atlas
Launch Operations	GLS	84K01340-200	Scout
	INT	84K01380-200	Scout
	LH2	84K01420-200	Scout
	LO2	84K01430-200	Scout
	MST	84K01460-200	Scout

1.3 OPERATIONAL AND FUNCTIONAL OVERVIEW

Facilities Supported

When these IPT's complete the software development and validation effort (post-Atlas), the developed software will operate from the listed CLCS Control Rooms to support the following facilities and end items.

IPT	CLCS Control Room	Facilities Supported	End Items
HMF	HMF	HMF	Vehicle Pods, GSE

IPT	CLCS Control Room	Facilities Supported	End Items
Vehicle Power Up/Down	OCR	OPF, VAB, Pad	Vehicle, GSE
Orbiter/SRB Hydraulics	OCR	OPF, MLP	GSE
HAZGAS	OCR	OPF, MLP, Pad, HGDS Lab (VAB)	GSE
Cryogenics, Main Propulsion and FIREX Water	OCR	OPF, MLP, Pad	GSE
Launch Operations	OCR	Pad	Vehicle, GSE

Operational Capabilities

When these IPT's complete the software development and validation effort (post-Atlas), the developed software will provide System Engineers with the following capabilities.

HMF

- Perform power up and down of the vehicle pods and Ground Support Equipment (GSE)
- Pressurize and vent Helium tanks
- Safe, pressurize, and vent fuel and oxidizer propellant tanks
- Perform Helium regulator flow
- Perform GSE valve checks
- Provide control and monitoring of vehicle and GSE equipment

Vehicle Power Up/Down

- Perform Vehicle and GSE Power Up and Down
- Provide control and monitoring of:
  - GSE based power supplies
  - Orbiter bus system
  - Basic orbiter instrumentation system
  - Orbiter and ground cooling
  - Basic Data Processing System

Orbiter/SRB Hydraulics

- Perform hydraulic pump GSE checkout
- Provide hydraulic supply to the Orbiter and SRB's for flight control testing (Flight Controls is a future IPT)

HAZGAS

- Provide maintenance support and monitoring of:
  - Hazardous Warning System leak and fire detection system
  - Hazardous Gas Detection System mass spectrometers
  - OMS hypergolic vapor detection system

Cryogenics, Main Propulsion and FIREX Water

- Provide control and monitoring of GSE including:
  - Main Propulsion and SSME ground systems
  - Liquid hydrogen ground system
  - Liquid oxygen ground system

Launch Operations

- Perform and coordinate Shuttle launch countdown operations

1.4 RTC IPT SPECIFICATION

1.4.1 Statement of Work

HMF

Highlights:

- Complete development of Forward Reaction Control System application software
- Complete development of Aft Propulsion System application software
- *Complete validation of Forward Reaction Control System and Aft Propulsion System application software (post Atlas)*

Statement Of Work

- Continue development of the Forward Reaction Control System and Aft Propulsion System Application software:
    - Finalize the Aft Propulsion System Functional Requirements Document
    - Finalize Forward Reaction Control System / Aft Propulsion System Software Design Specification
    - Complete Forward Reaction Control System / Aft Propulsion System Display development and integration with End Item Managers
    - Complete Forward Reaction Control System / Aft Propulsion System End Item Managers and automated Sequencers
    - Perform unit and integrated testing of Forward Reaction Control System / Aft Propulsion System software against an SGOS model
    - Prepare final validation test plans and procedures.
- Perform development of the Guidance (GUI) OMS TVC application software that is used during RTC operations:
    - Finalize GUI Functional Requirements Document
    - Finalize GUI Software Design Specification
    - Complete GUI display, End Item Manager and Sequencer
- Prepare final validation test plans and procedures
- Develop OMI and TPS updates.

Vehicle Power Up/Down

Highlights:

- Develop ECL, EPD, INS, and DPS application software required to support power application activities
- Develop integrated Displays and Sequencers to support power up/down activities

Statement Of Work

- Finalize the Functional Requirements Document sections of the following CSCIs that apply to the power up/down activities: ECL, EPD, INS, DPS, and INT.
- Start development of the integrated operations application software
    - Develop the Software Design Specification sections of the following CSCIs that apply to the power up/down activities: ECL, EPD, INS, DPS, and INT.
    - Develop required system and integrated Displays and integrated End Item Managers and Sequencers
    - Develop automated Sequences for power-up and power-down tasks.
- Begin development of validation test plans and procedures
- Begin development of OMI and TPS updates.

Orbiter/SRB Hydraulics

Highlights:

- Development of the Real-Time Control Application Software required for the checkout and operation of the Orbiter and SRB Hydraulics GSE

Statement Of Work

- Develop the Orbiter (HYD) and SRB (BHY) Hydraulics GSE application software:
    - Develop and finalize the GSE sections of the Functional Requirements Document
    - Develop and finalize the Software Design Specification for each system
    - Complete Display development and integration with End Item Manager for each system
    - Begin development of validation test plans and procedures for each system
- *Perform validation testing of HYD and BHY application software against an SGOS model (post-Atlas)*
- Begin development of OMI and TPS updates.

HAZGAS

Highlights:

- Development of the Real-Time Control Application Software required for the checkout and operation of HGD/HWS GSE including (as a minimum):

- Prime, Backup and HUMS Mass Spectrometer Systems
- Hypergolic Vapor Detection Systems
- Pad FCP Hydrogen Leak, Fire and Remote Detection Systems
- OPF FCP Hydrogen Leak Detection Systems
- Pad and MLP LH2 Leak, Fire and Remote Detection Systems
- PAD EGRESS Fire and Temperature Detection Systems
- HGDS Lab Hot-Bed Test-Unit (HBTU) and Vandenburg (VLS) UTI Mass Spectrometers Systems

Statement Of Work

- Develop the HGD/HWS application software:
  - Develop and finalize the Functional Requirements Document
  - Develop and finalize the Software Design Specification
  - Begin Test Application Display and End Item Manager development. *(completion will be post-Atlas)*
  - Begin development of validation test plans and procedures for each system
- *Perform validation testing of HGD/HWS application software against an SGOS model (post-Atlas)*
- Begin development of OMI and TPS updates.

Cryogenics, Main Propulsion and FIREX Water

Highlights:

- Definition of the Real-Time Control Application Software required for the checkout and operation of the LH2, LO2, MPS, SME and WAT GSE.

Statement Of Work

- Begin development of the LH2, LO2, MPS, SME and WAT GSE applications software.
  - Develop and finalize the GSE sections of the Functional Requirements Document for each system
  - Develop the Software Design Specification for each system.
  - Begin Display development and integration with End Item Managers for each system
- Begin End Item Manger and automated Sequencer development for each system.
- Assess OMI and TPS update effort.

Launch Operations

Highlights:

- Establish the goals and objectives of the launch operations development

Statement Of Work

- Conduct launch operations philosophy discussions to establish the foundation for the Ground Launch Sequencer and related launch operations tasks for the CLCS environment.
    - Review activities from T-6 hours post-launch securing
    - Explore changing roles during launch countdown during the T-6 through T-0 time-frame
    - Evaluate today's tasks and determine what is good to keep and what can be changed to improve operations
- Produce a report defining the top three strategies for launch operations and begin discussions on their merits and disadvantages.

1.4.2 Requirements

Detailed Application Software functional requirements for these IPT's will be documented in the Functional Requirements Document (FRD) for each CSCI. The requirements for software components which are reused by multiple CSCI's will be placed in the FRD for CAS. The individual CSCI's FRD will then just reference the requirements in the CAS FRD.

IPT	CSCI	FRD	Delivery Produced
All	CAS	84K01250-100	Atlas
HMF	HMF	84K01360-100	Thor (FRCS), Atlas (APS)
Vehicle Power Up/Down	DPS	84K01280-100	Atlas
	ECL	84K01290-100	Atlas
	EPD	84K01320-100	Atlas
	INS	84K01400-100	Atlas
	INT	84K01380-100	Atlas
	MST	84K01460-100	Atlas
Orbiter/SRB Hydraulics	BHY	84K01230-100	Atlas
	HYD	84K01350-100	Atlas
HAZGAS	HWS	84K01370-100	Atlas
Cryogenics, Main Propulsion and FIREX Water	LH2	84K01420-100	Atlas
	LO2	84K01430-100	Atlas
	MPS	84K01450-100	Atlas
	SME	84K01500-100	Atlas
	WAT	84K01510-100	Atlas
Launch Operations	GLS	84K01340-100	Scout
	INT	84K01380-100	Scout
	LH2	84K01420-100	Scout
	LO2	84K01430-100	Scout
	MST	84K01460-100	Scout

1.5 RTC IPT HARDWARE DIAGRAM

Not applicable.

1.6 RTC IPT DELIVERABLES

The following products will be delivered by the IPT's during the Atlas delivery. Application software will be developed but not validated during this timeframe. Items which will only be partially developed during the Atlas timeframe are indicated with a "P"; items which will be completed for Atlas are indicated with a "C".

IPT	Functional Requirements Document	Overview Design Specification	Detailed Design Specification	Software	Validation Test Procedures	OMI's
HMF	C	C	P	P	P	P
Vehicle Power Up/Down	C	C	P	P	P	
Orbiter/SRB Hydraulics	C	C	P	P	P	
HAZGAS	C	C	P	P	P	
Cryogenics, Main Propulsion and FIREX Water	P	P	P	P		
Launch Operations	See Note					

Note: The Launch Operations IPT will develop pre-requirements strategy options for the concept of launch operations.

1.7 RTC IPT ASSESSMENT SUMMARY

1.7.1 Labor Assessments

IPT	LM for Rqmts	LM for Development	
		Atlas	Post-Atlas
HMF	10	36	10
Power Up/Down	36	48	48
Hydraulics GSE	10	14	10
HazGas	10	10	10
Cryogenics GSE	40	14	48
Launch Operations	TBD	TBD	TBD
CAS	2	3	4
Totals	108	125	130

1.7.2 Hardware Costs

None.

1.7.3 RTC IPT Procurement

The following licenses are required for all RTC IPT's to perform software development.

Product	Licenses
SL-GMS	N/A – currently have site license
ControlShell	Additional 25 block of licenses
CORBA	Additional 15 licenses
DOORS	Additional 10 licenses

1.8 RTC IPT SCHEDULE & DEPENDENCIES

1.8.1 Schedule

Task Name	Start	Finish
Atlas Assessment Kickoff	2/12/98	
Concept Panel Internal Review		3/20/98
Concept Panel		3/20/98
IPT Development		
HMF		
Functional Requirements Development	1/15/98	6/1/98
RTC Applications Development	4/1/97	10/30/98
Software Validation	10/1/98	3/29/99
Vehicle Power Up/Down		
Functional Requirements Development	1/15/98	5/1/98
RTC Applications Development	5/1/98	2/18/99
Software Validation	2/19/99	3/25/99
Orbiter/SRB Hydraulics		
Functional Requirements Development	3/9/98	7/24/98
RTC Applications Development	6/15/98	10/2/98
Software Validation	10/5/98	11/6/98
HAZGAS		
Functional Requirements Development	3/9/98	7/24/98
RTC Applications Development	6/15/98	10/30/98
Software Validation	11/2/98	12/4/98
Cryogenics, Main Propulsion and FIREX Water		
Functional Requirements Development	5/1/98	10/15/98
RTC Applications Development	8/21/98	1/28/99
Software Validation	1/29/99	3/25/99
Launch Operations		
Strategy Option Development	4/1/98	9/25/98
Atlas Development Complete		9/25/98

1.8.2 Dependencies

	Planned Delivery	IPTs

CLCS System Capability	Thor	Atlas	Titan	Scout	HMF	PwrUp/Dwn	HYD GSE	HazGas	Cryo Gse
System Services									
System Message Services	X				X	X	X	X	X
Utility Services (e.g. print)	X				X	X	X	X	X
Initialization and Termination Services	X				X	X	X	X	X
Checkpoint/Restart		X			X	X	X	X	X
Application Services									
FD Services - support for all GSE types									
- support for all GSE types	X				X	X	X	X	X
- support for all vehicle types		X				X			
- support for enumerated and string types	X				X	X			
User Display Services	X				X	X	X	X	X
Subsystem Services									
- Gateway Control Functions		X			X	X	X	X	X
- On-Board Functions		X				X			
- EIU Functions			X						
- MDM Functions		X	X			X			
- MEC Functions			X						
- SCA Functions			X						
- Uplink Functions			X						
- GPC/DEU/SSME Memory Functions		X	X			X			
- TCS-1 Functions		X	X			X			
- PDI Functions			X						
- Launch Sequence Functions			X						
- On-Board ECP Functions			X						
Inter-Application Communication Services	X				X	X	X	X	X
Data Path Services		X			X	X	X	X	X
End Item Manager Services (maps to FD Services)		X			X	X	X	X	X
PCL Services	X					X	X	X	X
TCS-Sequence Functions									
Data Distribution									
Data Health - both data path and user defined path									
- Data Integrity (e.g. gateway, HIM)	X				X	X	X	X	X
- Data Path (e.g. power supply, Sig Cond)		X			X	X	X	X	X
Data Fusion	X				X	X	X	X	X
Display Attribute		X			X	X	X	X	X
Constraint Management									
- Atomic Constraints	X				X	X	X	X	X
- Summary Constraints		X				X			

CLCS System Capability	Planned Delivery				IPTs				
	Thor	**Atlas**	**Titan**	**Scout**	**HMF**	**PwrUp/Dwn**	**HYD GSE**	**HazGas**	**Cryo Gse**
- Compound Constraints		X							
System Viewers									
Constraint Viewer	X				X	X	X	X	X
FD Viewer	X				X	X	X	X	X
System Message Viewer	X				X	X	X	X	X
Plot	X				X	X	X	X	X
DMON	X				X	X	X	X	X
Command and Navigation System									
HMP support	X				X	X	X	X	X
Dual head support		X			X	X	X	X	X
VFP support		X			X	X	X	X	X
Subsystem Integrity		X			X	X	X	X	X
Data Recording and Retrieval	X				X	X	X	X	X
Simulation Support									
GSE Data	X				X	X	X	X	X
PCM/LDB Data		X				X			
Gateways									
GSE	X				X	X	X	X	X
PCM	X					X			
LDB	X					X			
ME		X							
CSGW		X							
PLD		X							
Uplink			X						
LDB Commands									
Set, Issue, Apply, Status		X				X			
BITE Tests		X				X			
GMEM Reads		X				X			
DEUE's		X				X			
MDM Reads		X				X			
LDB Control		X				X			
Data Acquisition		X				X			
Read SIO		X							
Command Management									

CLCS System Capability	Planned Delivery				IPTs				
	Thor	Atlas	Titan	Scout	HMF	PwrUp/Dwn	HYD GSE	HazGas	Cryo Gse
Command Processor	X				X	X	X	X	X
Command Authentication	X					X	X	X	X
PCL Blocking	X				X	X	X	X	X
Data Persistence		X			X	X	X	X	X

1.9 RTC IPT SIMULATION REQUIREMENTS

The following are the simulation requirements applicable to all IPT's.

Testing Phase	Facility	Simulation Required
Unit Testing	DDE	CVT Stuffer for non-dynamic testing, CDS or SIM Rehost Model for dynamic testing
	SDE	CVT Stuffer for non-dynamic testing, CDS or SIM Rehost Model or SIM Gateway for dynamic testing
Integrated Testing	SDE or IDE	CDS or SIM Rehost Model or SIM Gateway
Validation (after Atlas)	IDE	Validated CDS or SIM Rehost Model

1.10 RTC IPT INTEGRATION AND SYSTEM TEST PLAN

Unit and Integrated Testing will be performed by the IPT software developers in a DDE, SDE, or IDE environment. Validation will be performed by the system engineers in an IDE environment. This Validation will verify that the software meets the Functional Requirements. Validation Test Procedures will be developed by the system engineers. All testing will follow the RTC Application Software Development Plan (84K00070-200).

1.11 RTC IPT TRAINING REQUIREMENTS

1.11.1 Training Needed

Class	Number of People
ControlShell	30 Developers
CORBA	20 Developers
DOORS	30 Systems Engineers and Developers
Real-Time Control Application Software Orientation	20 Systems Engineers and Developers

1.11.2 Training to be provided

Training of System Engineers in the use of the RTC Application Software will be done through participation in the Application Software Validation (post-Atlas), preparation of OMI's, and any desired simulation runs and training exercises.

1.12 RTC IPT FACILITIES REQUIREMENTS

SDE or IDE facilities are required for software integrated testing. Validation, which will take place immediately after the Atlas delivery, will require an IDE facility.

The following control room support (SDE or IDE) is required to perform debug and validation testing. Note: Validation of RTC Application Software must be performed against fully validated System Software and hardware.

		Gateways									
IPT	**CCWS**	**GS1**	**GS2**	**GS3**	**GS4**	**GS5**	**OI**	**LDB**	**GPC**	**DDP**	**CCP**
HMF	2	X	X							X	1
PwrUp	4	X	X	X	X	X	X	X	X	X	2
Hyd	2	X	X		X	X				X	1
HazGas	1	X	X	X	X					X	1
Cryo	2	X	X	X	X					X	1

The following estimated hours of control room support are required to perform RTC Application Software validation testing.

IPT	Control Room Hours
HMF	960
PwrUp	200
Hyd	160
HazGas	160
Cryo	320

1.13 TRAVEL REQUIREMENTS

None for Atlas.

1.14 RTC IPT ACTION ITEMS/RESOLUTION

2. CSCI ASSESSMENTS

2.1 CSCI ASSESSMENT

IPT Work Required

The following items are targeted to be worked in the Atlas timeframe. Items which will only be partially developed during the Atlas timeframe are indicated with a "P"; items which will be completed for Atlas are indicated with a "C".

IPT	Develop Functional Requirements	Develop Software Design Spec.	Develop RTC Application Software	Perform Unit and Integrated Testing	Develop Validation Test Procedures	Perform Validation	Update OMI's
HMF	C	C	P	P	P		P

IPT	Develop Functional Requirements	Develop Software Design Spec.	Develop RTC Application Software	Perform Unit and Integrated Testing	Develop Validation Test Procedures	Perform Validation	Update OMI's
Vehicle Power Up/Down	C	C	P	P	P		
Orbiter/SRB Hydraulics	C	C	P	P	P		
HAZGAS	C	C	P	P	P		
Cryogenics, Main Propulsion and FIREX Water	P	P	P	P			
Launch Operations	See Note						

Note: The Launch Operations IPT will develop pre-requirements strategy options for the concept of launch operations.

IPT Assessment

Detailed labor estimates for RTC Application Software development and validation will be developed for each CSCI's Requirements Review Panel.

3. HWCI ASSESSMENTS

None.